RAJEEV GANDHI MEMORIAL COLLEGE OF ENGINEERING AND TECHNOLOGY

AUTONOMOUS

Affiliated to JNTU-Anantapur, Approved by AICTE-New Delhi, Accredited by NBA-New Delhi, Accredited by NAAC of UGC NANDYAL-518501, KURNOOL DIST., A.P., INDIA

POWER ELECTRONICS

ESTD: 1995

ACADEMIC REGULATIONS, COURSE STRUCTURE AND DETAILED SYLLABUS

Applicable for students admitted into M.Tech (Regular) from 2012-13

RAJEEV GANDHI MEMORIAL COLLEGE OF ENGINEERING AND TECHNOLOGY,
NANDYAL-518501, KURNOOL (DIST), A.P., INDIA

AUTONOMOUS INSTITUTE
(Affiliated to J.N.T.U.A, Anantapur)

ACADEMIC REGULATIONS, COURSE STRUCTURE AND DETAILED SYLLABI

M.Tech (Regular) from 2012-13

For pursuing Two year Master (post graduate) Degree of study in Engineering (M.Tech), offered by Rajeev Gandhi Memorial College of Engineering and Technology, Nandyal - 518501 under Autonomous status and herein referred to as RGMCET (Autonomous):

All the rules specified herein approved by the Academic Council will be in force and applicable to students admitted from the Academic Year 2012-13 onwards. Any reference to "Institute" or "College" in these rules and regulations shall stand for Rajeev Gandhi Memorial College of Engineering and Technology (Autonomous).

All the rules and regulations, specified here after shall be read as a whole for the purpose of interpretation as and when a doubt arises, the interpretation of the Chairman, Academic Council is final. As per the requirements of statutory bodies, the Principal, Rajeev Gandhi Memorial College of Engineering and Technology shall be the Chairman, Academic Council.

Academic Regulations 2012 for M.Tech (Regular)

(Effective for the students admitted into first year from the Academic Year 2012-2013)
The M.Tech Degree of Jawaharlal Nehru Technological University, Anantapur, shall be conferred on candidates who are admitted to the M.Tech program at RGMCET, Nandyal and they shall fulfil all the requirements for the award of the Degree.

1.0 Eligibility for Admissions:

Admission to the above program shall be made subject to the eligibility, qualifications and specialization prescribed by Andhra Pradesh State Council of Higher Education (APSCHE) from time to time.

Admissions shall be made on the basis of merit rank obtained in GATE examination or PGCET conducted by any University of Andhra Pradesh designated by Govt. of A.P., or on the basis of any other order of merit prescribed by APSCHE, subject to the reservations prescribed by the Government of A.P. from time to time.

2.0 Award of M.Tech Degree:

2.1 The student shall be declared eligible for the award of the M.Tech degree, if he/she pursues a course of study and completes it successfully for not less than prescribed course work duration and not more than double the prescribed course work duration.

2.2 The student, who fails to fulfil all the academic requirements for the award of the degree within double the course work duration from the year of his admission, shall forfeit his seat in M.Tech course.

2.3 The minimum clear instruction days for each semester shall be 95.

3.0 Courses of Study:

The following specializations are offered at present for the M.Tech course of study.

1. Computer Science(CSE)
2. Digital Systems and Computer Electronics(ECE)
3. Embedded Systems(ECE)
4. Machine Design(Mechanical)
5. Power Electronics(EEE)
6. Software Engineering(IT)

and any other course as approved by the appropriate authorities from time to time.

4.0 Course pattern:

4.1 The entire course of study is of four semesters. During the first and second semesters the student has to undergo course work and during the third and fourth semesters the student has to carry out project work.

4.2 The student shall be eligible to appear for the End Examination in a subject, but absent at it or has failed in the End Examination may appear for that subject at the supplementary examination.

Table 1: Credits

	Semester			
	Periods / Week	Credits	Internal marks	External marks
Theory	04	04	40	60
Practical	03	02	40	60
Seminar		02	100	
Comprehensive Viva-voce1		02		50
Comprehensive Viva-voce2		02		50
Project		12		

Table:2 Course pattern

Semester	No.of Subjects	Number of Labs	Total credits	
First	06	02 Comprehensive Viva1	6X4=24 2X2=04 1X2=02	30

Second	06	02 Comprehensive Viva2	6X4=24 2X2=04 1X2=02	30
Third	Seminar(3rd semester) Project Work			02 12
Fourth				
Total credits				74

5.0 Attendance:

5.1 The candidate shall be deemed to have eligibility to write end semester examinations if he has secured a minimum of 75% of attendance in aggregate of all the subjects.

5.2 Condonation of shortage of attendance up to 10% i.e. 65% and above and below 75% may be given by the College academic committee consisting of Principal, Head of the Department and a senior faculty member.

5.3 Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence.

5.4 **Shortage of attendance below 65% shall in no case be condoned.**

5.5 The candidate shall not be promoted to the next semester unless he fulfils the attendance requirements of the previous semester.

6.0 Evaluation:

The performance of the candidate in each semester shall be evaluated subject wise, with a maximum of 100 marks for Theory and 100 marks for practicals, on the basis of Internal Evaluation and End Semester Examination.

6.1 For the theory subjects 60 marks shall be for the External End Examination, While 40 marks shall be for Internal Evaluation, based on the better of the marks secured in the two Mid Term-Examinations held, one in the middle of the Semester (I-IV units) and another immediately After the completion of instruction (V-VIII) units with four questions to be answered out of six, evaluated for 40 marks. Each question carries 10 marks. Each midterm examination shall be conducted for duration of 120 minutes. The End Examination will have 08 questions and 5 questions are to be answered and each question carries 12 marks.

6.2 For practical subjects, 60 marks shall be for the End Semester Examinations and 40 marks shall be for Internal evaluation based on the day-to-day performance. End practical examinations will be conducted with two Examiners, one of them being Laboratory Class Teacher and second Examiner shall be external from other institution. For this, HOD of the Department shall submit a panel of 5 Examiners, who are eminent in that field. One from the panel will be selected by the principal of the institute as external Examiner for laboratory.

6.3 Student has to undergo a comprehensive viva pertaining to his specialization which carries 50 marks in each semester. He has to secure 50% marks to obtain required

credits. Comprehensive viva will be held at the end of I and II semesters by the committee consisting of HOD, senior faculty member and external Examiner from outside the institute. For this, HOD of the Department shall submit a panel of 5 Examiners, who are eminent in that field. One from the panel will be selected by the principal of the institute as external Examiner for comprehensive viva.

6.4 For Seminar 100 marks shall be for Internal evaluation. The candidate has to secure a minimum of 50 marks to be declared successful. The assessment will be made by a board consisting of HOD and two Internal experts at the end of III semester.

6.5 The candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Examination and Internal evaluation taken together.

6.6 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 6.5.) he has to reappear for the Semester Examination either supplementary or regular in that subject, or repeat the course when next offered or do any other specified subject as may be required.

7.0 Re-registration for improvement of Internal marks:

Following are the conditions to avail the benefit of improvement of Internal marks.

7.1 The candidate should have completed the course work and obtained examinations results for I & II semesters.

7.2 He should have passed all the subjects for which the Internal marks secured are more than 50%.

7.3 Out of the subjects the candidate has failed in the examination due to Internal marks secured being less than 50%, the candidate shall be given one chance for each Theory subject and for a maximum of three Theory subjects for Improvement of Internal marks.

7.4 The candidate has to re-register for the chosen subjects and fulfil the academic requirements as and when they are offered.

7.5 For each subject, the candidate has to pay a fee equivalent to one tenth of the semester tuition fee and the amount is to be remitted in the form of D.D. in favour of the Principal, RGMCET payable at RGMCET Nandyal branch along with the requisition through the HOD of the respective Department.

7.6 In case of availing the Improvement of Internal marks, the Internal marks as well as the End Examinations marks secured in the previous attempt(s) for the reregistered subjects stand cancelled.

8.0 Evaluation of Project / Dissertation work :

Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the Department.

8.1 Registration of Project work: The candidate is permitted to register for the project work after satisfying the attendance requirement of all the courses (theory and practical courses of I & II Sem)

8.2 An Internal Department Committee (I.D.C) consisting of HOD, Supervisor and One Internal senior expert shall monitor the progress of the project work.

8.3 The work on the project shall be initiated in the penultimate semester and continued in the final semester. The duration of the project is for two semesters. The candidate can submit Project thesis with the approval of I.D.C. after 36 weeks from the date of registration at the earliest. Extension of time within the total permissible limit for completing the programme is to be obtained from the Head of the Institution.

8.4 The student must submit status report at least in three different phases during the project work period. These reports must be approved by the I.D.C before submission of the Project Report.

8.5 The candidate shall be allowed to submit the thesis/dissertation only after passing in all the prescribed subjects (both theory and practical) and then take viva voce examination of the project. The viva voce examination may be conducted once in two months for all the candidates submitted during that period.

8.6 Three copies of the Thesis/Dissertation certified in the prescribed form by the supervisor & HOD shall be submitted to the institute.

8.7 The Department shall submit a panel of 5 experts for a maximum of 5 students at a time. However, the thesis/dissertation will be adjudicated by the board consists of HOD, concerned supervisor and one external Examiner from other institute nominated by the principal from a panel of Examiners submitted by the Department HOD to the Controller of Examinations.

8.8 If the report of the board is favourable in viva voce examination, the board shall jointly report candidates work as:

1. Satisfactory
2. Not satisfactory

If the report of the viva voce is not satisfactory the candidate will retake the viva voce examination after three months. If he fails to get a satisfactory report at the second viva voce examination he will not be eligible for the award of the degree unless the candidate is permitted to revise and resubmit the thesis.

9.0 Award of Degree and Class:

After the student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree he shall be placed in one of the following classes:

Table 3: Award of division

Class Awarded	% of marks to be secured	

First Class with Distinction	70% and above	From the aggregate marks secured from the 74 Credits.
First Class	Below 70% but not less than 60%	
Second Class	Below 60% but not less than 50%	

(The marks in Internal evaluation and End Examination shall be shown separately in the marks memorandum)

10.0 Supplementary Examinations:

Apart from the regular End Examinations the institute may also schedule and conduct supplementary examinations for all subjects for the benefit of students with backlogs. Such of the students writing supplementary examinations as supplementary candidates may have to write more than one examination per day.

11.0 Transcripts:

After successful completion of prerequisite credits for the award of degree a Transcript containing performance of all academic years will be issued as a final record. Duplicate transcripts will also be issued if required after the payment of requisite fee and also as per norms in vogue.

12.0 Minimum Instruction Days:

The minimum instruction days for each semester shall be 95 clear instruction days excluding the days allotted for tests/examinations and preparation holidays declared if any.

13.0 Amendment of Regulations:

The college may, from time to time, revise, amend or change the regulations, scheme of examinations and syllabi. However the academic regulations of any student will be same throughout the course of study in which the student has been admitted.

14.0 Transfers

There shall be no branch transfers after the completion of admission process.

15.0 With holding of results:

If the candidate has not paid any dues to the institute or if any case of in-discipline is pending against him, the result of the candidate will be with held and he will not be allowed for the next semester. The issue of the degree is liable to be withheld in such cases.

16.0 Transitory Regulations:

Candidates who have discontinued or have been detained for want of attendance are eligible for admission to the same or equivalent subjects as and when subjects are offered, subject to 6.5 and 2.0

17.0 Rules of Discipline:

17.1 Any attempt by any student to influence the teachers, Examiners, faculty and staff of controller of Examination for undue favours in the exams, and bribing them either for marks or attendance will be treated as malpractice cases and the student can be debarred from the college.

17.2 When the student absents himself, he is treated as to have appeared and obtained zero marks in that subject(s) and grading is done accordingly.

17.3 When the performance of the student in any subject(s) is cancelled as a punishment for indiscipline, he is awarded zero marks in that subject(s).

17.4 When the student's answer book is confiscated for any kind of attempted or suspected malpractice the decision of the Examiner is final.

18.0 General:

18.1 The Academic Regulation should be read as a whole for the purpose of any interpretation.

18.2 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the College Academic Council is final.

18.3 The Institute may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the Institute.

18.4 *Where the w*ords "he", "him", "his", occur in the regulations, they include "she", "her", "hers".

RAJEEV GANDHI MEMORIAL COLLEGE OF ENGINEERING AND TECHNOLOGY, NANDYAL

AUTONOMOUS

ELECTRICAL & ELECTRONICS ENGINEERING

POWER ELECTRONICS
COURSE STRUCTURE

M.Tech - I Semester (Power Electronics) **Regulation: RGM-R-2012**

S. No	Course Code	Subject	Credits	Theory	Practical	Scheme of Evaluation		
						Internal	End	Total
1	D4301121	Renewable Energy Sources	4	4	-	40	60	100
2	D4302121	Analysis of Power Electronic Converters	4	4	-	40	60	100
3	D4303121	Modeling of Conventional Machines	4	4	-	40	60	100
4	D4304121	Power Electronic Control of DC Drives	4	4	-	40	60	100
5	D4305121	Modern Control Theory	4	4	-	40	60	100
6	**Elective-I**							
	D4306121	Power Quality	4	4	-	40	60	100
	D4307121	Soft Computing Techniques						
	D4308121	Micro Controllers & Applications						
	D0606121	VLSI Technology						
7	D4391121	Power Converters Lab	2	-	3	40	60	100
8	D4392121	Simulation of Power Converters Lab	2	-	3	40	60	100
9	D4393121	Comprehensive Viva-I	2	-	-	-	50	50
Total			**30**	**24**	**6**	**320**	**530**	**850**

M.Tech - II Semester (Power Electronics) **Regulation: RGM-R-2012**

S. No	Course Code	Subject	Credits	Theory	Practical	Scheme of Evaluation		
						Internal	End	Total
1	D4307122	Advanced Power Semi Conductor Devices & Protection	4	4	-	40	60	100
2	D4308122	Modern Power Electronics	4	4	-	40	60	100
3	D4309122	Special Machines & Control	4	4	-	40	60	100
4	D4310122	Power Electronic Control of AC Drives	4	4	-	40	60	100
5	D4311122	FACTS controllers & Applications	4	4	-	40	60	100
6	**Elective-II**							
	D4312122	HVDC Transmission	4	4	-	40	60	100
	D4313122	Digital Control Systems						
	D0609122	Micro computer system design						
	D5504122	Embedded System design						
7	D4394122	Power Electronic Drives Lab	2	-	3	40	60	100
8	D4395122	Power System Simulation Lab	2	-	3	40	60	100
9	D4396122	Comprehensive Viva-II	2	-	-	-	50	50
Total			**30**	**24**	**6**	**320**	**530**	**850**

M.Tech – III Semester (Power Electronics) **Regulation: RGM-R-2012**

S.No	Course Code	Subject	Credits	Internal Marks	External Marks	Total Marks
1	D4397123	Seminar	2	100	-	100

M.Tech – IV Semester (Power Electronics) **Regulation: RGM-R-2012**

S.No	Course Code	Subject	Credits	Internal Marks	External Marks	Total Marks
1	D4398124	Project Work	12	100	-	100

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ELECTRICAL & ELECTRONICS ENGINEERING

M.Tech (Power Electronics) I-Sem	**T**	**P**	**C**
	4	**0**	**4**

(D4301121) RENEWABLE ENERGY SOURCES

UNIT I PRINCIPLES OF SOLAR RADIATION

Solar energy option- Physics of Sun- Terrestrial and Extraterrestrial Solar Radiation- Instruments for Measuring Solar Radiation-Flat Plate and Concentrating Collectors-Advanced Collectors

UNIT II PHOTOVOLTAIC CONVERSION

Generation of Electricity by Photovoltaic Effect, PV cell, Module and array, equivalent electrical circuit, open circuit and short circuit current, i-v and p-v curves, series and parallel connection of PV cells

UNIT III WIND ENERGY-I

Historical back ground, power contained in wind, thermodynamics of wind energy, efficiency limit for wind energy conversion, maximum energy obtainable for a thrust-operated converter, types of wind energy conversion devices, some relevant definitions, aerodynamics, design of wind turbine rotor, power speed, torque-speed characteristics, wind turbine control systems, control strategy

UNIT IV WIND ENERGY-II

Grid connected and self excited induction generator operation, constant voltage, constant frequency generation, reactive power compensation, variable voltage, variable frequency generation, effect of wind generator on the network, doubly fed induction generator, wound field synchronous generators, the permanent magnet generators

UNIT V BIOMASS

Biomass energy - Bio fuel classification – Examples of thermo chemical, Pyrolysis, biochemical and agrochemical systems –Ethanol production and use – Anaerobic digestion for biogas – Different digesters – Digester sizing – Applications of Biogas - Operation with I.C.Engine

UNIT VI OCEAN ENERGY

OTEC Principle - Lambert's law of absorption - Open cycle and closed cycle - heat exchanger calculations – Major problems and operational experience

UNIT-VII TIDAL POWER

Principles of power generation - components of power plant – Single and two basin systems – Turbines for tidal power - Estimation of energy – Maximum and minimum power ranges - tidal powerhouse

Wave Energy: Concept of energy and power from waves – Wave characteristics – period and wave velocities - Different wave energy conservation devices (Saltor duck, oscillating water column and dolphin types) – operational experience.

UNIT-VIII GEOTHERMAL ENERGY

Classification- Fundamentals of geophysics - Dry rock and hot aquifier energy analysis - Estimation of thermal power - Extraction techniques - Prime movers.

TEXT BOOKS

1. Renewable Energy Resources / John Twidell and Tony Weir / E & F.N.Spon
2. Renewable Energy Resources Basic Principles and Applications / G.N.Tiwari and M.K.Ghosal / Narosa

3. Solar Energy - Principles of thermal collection and storage/ S.P. Sukhatme / TMH
4. Wind Electrical Systems- S.N.Bhadra, D. Kastha, S. Banerjee Oxford University press.
5. Non-conventional energy sources- G.D. Rai

REFERENCES:

1. Integration of alternative sources of energy- Felix a. Farret, M. Godoy simoes- A John Wiley & Sons, inc., publication
2. Fundamentals of Renewable Energy Systems – D. Mukerjee, S.Chakrabarthi. New Age International Publishers
3. Renewable and Efficient Electric Power Systems - By Gilbert M. Masters, John Wiley & Sons Inc Publications
4. Advanced Renewable Energy Sources By Gopal Nath Tiwari, Rajeev Kumar Mishra, RSC publishing
5. Non-Conventional Energy Resources By B H Khan, Tata Mc Graw-Hill publishing company Ltd.

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ELECTRICAL & ELECTRONICS ENGINEERING

M.Tech (Power Electronics) I-Sem	**T**	**P**	**C**
	4	**0**	**4**

(D4302121) ANALYSIS OF POWER ELECTRONICS CONVERTERS

UNIT I SINGLE PHASE AC VOLTAGE CONTROLLERS

Single Phase AC Voltage Controllers with resistive, resistive-inductive and resistive-inductive-induced e.m.f loads-ac voltage controller's wit PWM control-Effects of source and load inductances –synchronous tap changers –Applications- numerical problems

UNIT II THREE PHASE AC VOLTAGE CONTROLLERS

Three Phase AC Voltage controllers-Analysis of Controllers with star and delta connected resistive, resistive –inductive loads-Effects of source and load inductances–Application- numerical problems.

UNIT III CYCLOCONVERTERS

Single phase to single phase cycloconverters –analysis of midpoint and bridge configurations-three phase to three phase cycloconverters-analysis of Midpoint and bridge configurations-Limitations-Advantages-Applications

UNIT IV SINGLE PHASE CONVERTERS

Single phase Half controlled and Fully controlled Converters – Evaluation of input power factor and harmonic factor-Continuous and Discontinuous load current-Single phase dual converters-Power factor improvements-Extinction angle control-symmetrical angle control- single phase sinusoidal PWM-Application- numerical problems

UNIT V THREE PHASE CONVERTERS

Three Phase Converters- Half controlled and fully controlled Converters – Evaluation of input power factor and harmonic factor-Continuous and Discontinuous load current-three phase dual converters-Power factor improvements-three phase PWM-twelve pulse converters–Application- numerical problems

UNIT VI D.C TO D.C CONVERTERS

Analysis of step-down and step up dc to dc converters with resistive and resistive –inductive loads-Switched mode regulators- Analysis of Buck regulators-Boost Regulators-Buck-Boost Regulators-Cuk Regulators- Condition for continuous inductor current and capacitor voltage-Comparison of regulators-Multi output boost regulators –advantages –Application- numerical problems

UNIT VII PULSE WIDTH MODULATED INVERTERS (SINGLE PHASE INVERTER)

Principle of operation- Performance parameters- Single Phase bridge Inverters-Evaluation of output voltage and current with resistive and inductive loads-Voltage control of single phase inverters – Single PWM-Multiple PWM-Sinusoidal PWM-modified PWM-phase displacement control-Advanced Modulation techniques for improved performance , Trapezoidal, staircase ,stepped, harmonic injection and delta modulation – Advantage–-Application- numerical problems

UNIT VIII PULSE WIDTH MODULATED INVERTERS (THREE PHASE INVERTER)

Three Phase inverters-analysis of 180 degree condition of output voltage and current with resistive, inductive loads-analysis of 120 degree conduction-Voltage control of three phase inverters-sinusoidal PWM-third harmonic PWM-60 degree PWM –space vector modulation-Comparison of PWM

techniques-harmonic reduction –current source inverters-Variable dc link inverter –boost inverters- buck and boost inverter – inverter circuit design – Advantage-–Application- numerical problems

TEXT BOOKS:

1. Power Electronics by Md.H.Rashid –Pearson Education Third Edition -First Indian reprint 2004
2. Power Electronics By P.S.Bimbhra (2004), "Power Electronics", Khanna publishers.
3. Power Electronics- Ned Mohan, Tore M.Undeland and William P.Robbins –John Wiley & Sons -2nd Edition

REFERENCE BOOKS:

1. Power Electronics By M.S.Jamil Asghar Phi Publication.
2. Power Electronics By M.D.Singh and K.B.Khanchandani (2002, TMH).
3. Vedam Subrahmanyam (1997), "Power Electronics", New age international publishers.

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ELECTRICAL & ELECTRONICS ENGINEERING

M.Tech (Power Electronics) I-Sem	**T**	**P**	**C**
	4	**0**	**4**

(D4303121) MODELING OF CONVENTIONAL MACHINES

UNIT I BASIC CONCEPTS OF MODELING

Basic Two- pole DC machine – primitive 2-axis machine – Voltage & Current relationship – Torque equation

UNIT II DC MACHINE MODELING- I

Mathematical model of separately excited DC motor and DC series motor in state variable form – Transfer function of the motor – Numerical problems

UNIT III DC MACHINE MODELING- II

Mathematical model of DC shunt motor and DC Compound motor in state variable form – Transfer function of the motor - Numerical problems

UNIT IV TRANSFORMATIONS

Linear transformation- phase transformation (a, b, c to ά, β, o) – Active transformation (ά, β, o to d, q)

UNIT V MODELING OF THREE PHASE INDUCTION MACHINE

Circuit model of a 3 phase Induction motor – Linear transformation – Phase Transformation – Transformation to a Reference frame – Two axis model for Induction motor

UNIT VI DYNAMIC MODELING OF THREE PHASE INDUCTION MACHINE

Voltage and current Equation in stator reference frame – Equation rotor reference frame – Equations in a synchronously rotating frame – Torque equation – Equation in state – space form

UNIT VII MODELING OF THREE PHASE SYNCHRONOUS MACHINE

Circuit model of a 3Ph Synchronous motor – Two axis representation of Synchronous Motor.

UNIT VIII DYNAMIC ANALYSIS OF SYNCHRONOUS MACHINE

Voltage and current Equation in state – space variable form – Torque equation.

TEXT BOOKS:

1 Thyristor control of Electric Drives- Vedam Subramanayam
2 Generalized Machine Theory –Bimbra

REFERENCE BOOKS:

1. Analysis of electric machinery and Drive systems- Oleg wasynezul, Scott D.Sudhoff, Paul C. Krause
2. Electric Motor Drives - Modeling, Analysis& control -R.Krishnan- Pearson Publications-1st edition -2002

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(D4304121) POWER ELECTRONIC CONTROL OF DC DRIVES

UNIT 1 CONTROLLED BRIDGE RECTIFIER (1-Φ) WITH DC MOTOR LOAD

Separately excited DC motors with rectified single phase supply- single phase semi converter and single phase full converter for continuous and discontinuous modes of operation – power and power factor.

UNIT II CONTROLLED BRIDGE RECTIFIER (3-Φ) WITH DC MOTOR LOAD

Three phase semi converter and three phase full converter for continuous and discontinuous modes of operation – power and power factor – Addition of Free wheeling diode – Three phase double converter.

UNIT III THREE PHASE NATURALLY COMMUTATED BRIDGE CIRCUIT AS A RECTIFIER OR AS AN INVERTER

Three phase controlled bridge rectifier with passive load impedance, resistive load and ideal supply – Highly inductive load and ideal supply for load side and supply side quantities, shunt capacitor compensation, three phase controlled bridge rectifier inverter.

UNIT IV PHASE CONTROLLED DC MOTOR DRIVES

Three phase controlled converter, control circuit, control modeling of three phase converter – Steady state analysis of three phase converter control DC motor drive – Two quadrant, Three phase converter controlled DC motor drive – DC motor and load, converter.

UNIT V CURRENT AND SPEED CONTROLLED DC MOTOR DRIVES

Current and Speed controllers - current and speed feedback — Design of controllers - Current and Speed controllers – Motor equations – Filter in the speed feedback loop speed controller – current reference generator – current controller and flow chart for simulation – Harmonics and associated problems – sixh harmonics torque.

UNIT VI CHOPPER CONTROLLED DC MOTOR DRIVES

Principle of operation of the chopper – Four quadrant chopper circuit – Chopper for inversion – Chopper with other power devices – model of the chopper –input to the chopper – Steady state analysis of chopper controlled DC motor drives – rating of the devices – Pulsating torque.

UNIT VII CLOSED LOOP OPERATION OF DC MOTOR DRIVES

Speed controlled drive system – current control loop – pulse width modulated current controller – hysteresis current controller – modeling of current controller – design of current

UNIT-VIII SIMULATION OF DC MOTOR DRIVES

Dynamic simulations of the speed controlled DC motor drives – Speed feedback speed controller – command current generator – current controller.

TEXT BOOKS:

1. Power Electronics and motor control – Shepherd, Hulley, Liang – II Edition, Cambridge University Press
2. Electric motor drives modeling, Analysis and control – R. Krishnan – I Edition, Prentice Hall India.

REFERENCE BOOKS:

1. Power Electronic Circuits, Devices and Applications – M. H. Rashid – PHI, I Edition – 1995.
2. Fundamentals of Electric Drives – G. K. Dubey – Narosa Publications – 1995.
3. Power Semiconductor drives – S.B. Dewan and A. Straughen – 1975.

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ELECTRICAL & ELECTRONICS ENGINEERING

M.Tech (Power Electronics) I-Sem	**T**	**P**	**C**
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(D4305121) MODERN CONTROL THEORY

UNIT I MATHEMATICAL PRELIMINARIES

Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen values, Eigen Vectors and a Canonical form representation of Linear operators – The concept of state – State Equations for Dynamic systems – Time invariance and Linearity – Nonuniqueness of state model – State diagrams for Continuous – Time state models –

UNIT II STATE VARIABLE ANALYSIS

Linear Continuous time model for physical systems – Existence and Uniqueness of Solutions to Continuous – Time State Equations – Solutions – Linear Time Invariant Continuous – Time State Equations – State transition matrix and it's properties

UNIT III CONTROLLABILITY AND OBSERVABILITY

General concept of Controllability - General concept of Observability Controllability tests for Continuous – Time Invariant systems - Observability tests for Continuous - Time Invariant systems - Controllability and Observability of state model in Jordan Canonical form - Controllability and Observability Canonical forms of State model

UNIT IV NON LINEAR SYSTEMS – I

Introduction – Non Linear Systems – Types of Non – Linearities – Saturation – Dead – Zone – Backlash – Jump Phenomenon etc; - Singular Points – Introduction to Linearization of nonlinear systems, properties of Non Linear Systems – Describing function – describing function analysis of nonlinear systems- Stability analysis of Non – Linear systems through describing functions

UNIT V NON LINEAR SYSTEMS – II

Introduction to phase – plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase – plane analysis of nonlinear control systems.

UNIT VI STABILITY ANALYSIS

Stability in the sense of Lyapunov, Lyapunov's stability and Lyapunov's instability theorems – Stability Analysis of the Linear Continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method.

UNIT VII STATE FEEDBACK CONTROLLERS AND OBSERVERS

State Feedback Controller design through Pole Assignment – state observers: Full order and Reduced order

UNIT VIII OPTIMAL CONTROL

Introduction to optimal control – Formulation of optimal control problems – calculus of variations – fundamental concepts, functional, variation of functional – fundamental theorem of theorem of Calculus of variations – boundary conditions – constrained minimization – formulation using Hamiltonian method – Linear quadratic regulator

TEXT BOOKS:

1. Modern Control System Theory by M. Gopal – New Age International – 1984
2. Modern Control Engineering by Ogata. K – Prentice Hall – 1997

REFERENCE BOOKS :

1. Optimal control by Kirk.
2. Digital Control Engineering Kuo, Oxford University

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(D4306121) POWER QUALITY

UNIT 1 POWER AND VOLTAGE QUALITY

General, classes of Power Quality Problems, Power quality terms, Power frequency variations, the power quality evaluation procedure.

UNIT 2 VOLTAGE QUALITY

Transients, long and short duration Voltage variations, Voltage imbalance, waveform distortion, Voltage Flicker.

UNIT 3 VOLTAGE SAGS AND INTERRUPTIONS

Sources of sags and Interruptions. Estimating Voltage sag performance.

UNIT 4 FUNDAMENTAL PRINCIPLES OF PROTECTION

Solutions at the end-user level. Evaluating Ride-through Alternatives. Motor-Starting Sags.

UNIT 5 FUNDAMENTALS OF HARMONICS

Harmonic distortion. Voltage versus Current distortion. Harmonic indexes. Harmonic sources from commercial loads. Harmonic sources from industrial loads. Locating Harmonic sources. System response characteristics. Effects of Harmonic Distortion

UNIT 6 DISTRIBUTED GENERATION AND POWER QUALITY

Resurgence of DG. DG Technologies. Interface to the Utility System. Power Quality Issues. Operating Conflicts. DG on distribution Networks . Siting DG distributed Generation, Interconnection standards.

UNIT 7 WIRING AND GROUNDING

Resourses, Definitions, Reasons for Grounding, Typical wiring and grounding problems, Solution to wiring and grounding problems.

UNIT 8 POWER QUALITY MONITORING

Monitoring Consideration. Historical Perspective of power quality measurement equipment. Assessment of Power Quality.

REFERENCES:

1. Electrical Power Systems Quality'' by Roger C. Dugan, Mark E. Mc. Granaghan, Surya Santoso and H. Wayne Beaty,"Mc. Graw Hill, Second Edition.
2. "Understanding Power Quality Problems" by Math H J Bollen. IEEE Press.

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(D4307121) SOFT COMPUTING TECHNIQUES

UNIT-I OVERVIEW OF COURSE

Brief introduction to the platforms and required background for the course. Basics of Soft Computing-Introduction to Soft Computing. The main components and characteristics of Soft Computing

UNIT-II FUZZY LOGIC AND SYSTEMS

Fuzzy Sets and Membership Functions- Operations on Fuzzy Sets- Fuzzification- Fuzzy Numbers - Uncertain Fuzzy Values-Fuzzy Numbers and its L-R representation-Operations on Fuzzy Numbers-Fuzzy Relations-Cartesian product-Binary Fuzzy Relations. IF-THEN fuzzy relation-n-ary Fuzzy Relations-Compositions of Fuzzy Relations-max-min composition-max-product composition

UNIT-III FUZZY INFERENCE SYSTEMS

Architecture of Fuzzy Inference System-Fuzzy Inference Rules and Reasoning-Defuzzification-Applications of Fuzzy Logic -Fuzzy Control Systems-Pattern Analysis and Classification-Fuzzy Expert Systems

UNIT-IV NEURAL NETWORKS

Artificial Neural Networks-Models of Neuron-Architecture of Neural Networks-Feed-forward Neural Networks-Recurrent Neural Networks-Network layers-Perceptrons

UNIT-V LEARNING METHODS FOR NEURAL NETWORKS

Supervised Learning-Unsupervised Learning-Reinforcement Learning-Transfer Function- Back-Propagation Algorithm- Applications of Neural Networks-Neural Networks in Business-Neural networks in Medicine

UNIT-VI GENETIC ALGORITHMS

Genetic algorithms and evolutionary – computation - Basics of Genetic Algorithms-Representation methods -Selection -Crossover –Mutation

UNIT-VII APPLICATIONS OF GENETIC ALGORITHMS

Genetic Algorithms on optimization and planning-Traveling Salesman Problem-Genetic Algorithms in Business and their role in Decision Making-Intelligent Control Using Evolutionary Computation

UNIT-VIII HYBRID SYSTEMS

Fuzzy-Evolutionary System -Neuro-Fuzzy System - Neuro-Fuzzy-Evolutionary System -Neuro-Evolutionary System

TEXT BOOKS:

1. Neuro-Fuzzy and soft computing by J S R Jang, CT Sun and E.Mizutani , PHI PVT LTD.
2. Principles of soft computing –by sivandudam and Deepa publisher –John mikey India.

REFERENCE BOOKS:

1. S. Haykins- Neural Networks: A comprehensive foundation.

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(D4308121) MICROCONTROLLERS AND APPLICATIONS

UNIT I 8051 MICROCONTROLLERS

Introduction to Intel 8 bit & 16 bit Microcontrollers, MCS-51 Architecture, Registers in MCS-51, 8051 Pin Description, 8051 Connections, 8051 Parallel I/O Ports, Memory Organization

UNIT II MCS-51 ADDRESSING MODES AND INSTRUCTIONS

8051 Addressing Modes, MCS-51 Instruction Set, 8051 Instructions and Simple Programs, Using Stack Pointer, 8051 Assembly Language Programming, Development Systems and Tools, Software Simulators of 8051

UNIT III MCS-51 INTERRUPTS, TIMER/COUNTERS AND SERIAL COMMUNICATION

Interrupts, Interrupts in MCS-51, Timers and Counters, Serial Communication, Atmel Microcontrollers (89CXX and 89C20XX), Architectural Overview of Atmel 89C51 and Atmel 89C2051, Pin Description of 89C51 and 89C2051, Using Flash Memory Devices Atmel 89CXX and 89C20XX

UNIT IV APPLICATIONS OF MCS-51 AND ATMEL 89C51 AND 89C2051 MICROCONTROLLERS

Applications of MCS-51 and Atmel 89C51 and 89C2051 Microcontrollers- Square Wave Generation- Rectangular Waves- Pulse Generation- Pulse Width Modulation- Staircase Ramp Generation- Sine Wave Generation- Pulse Width Measurement- Frequency Counter

UNIT V PIC MICROCONTROLLERS

PIC Microcontrollers: Overview and Features, PIC 16C6X/7X, FSR(File Selection Register) [Indirect Data Memory Address Pointer], PIC Reset Actions, PIC Oscillator Connections, PIC Memory Organizations, PIC PIC 16C6X/7X Instructions, Addressing Modes, I/O Ports, Interrupts in PIC 16C61/71, PIC 16C61/71 Timers, PIC 16C71 Analog-to-Digital Converter (ADC)

UNIT VI PIC 16F8XX FLASH MICROCONTROLLERS

Introduction, Pin Diagram of 16F8XX, STATUS Register, OPTION_REG Register, Power Control Register (PCON), PIC 16F8XX Program Memory, PIC 16F8XX Data Memory, DATA EEPROM and Flash Program EEPROM, Interrupts in 16F877, I/O Ports, Timers

UNIT- VII

Interfacing and Microcontroller Applications-Light Emitting Diodes (LEDs), Push Buttons, Relays and Latch Connections, Keyboard Interfacing, Interfacing 7-Segment Displays, LCD Interfacing, ADC AND DAC Interfacing with 89C51 Microcontrollers

UNIT- VIII

Industrial Applications of Microcontrollers - Measurement Applications, Automation and Control Applications

REFERENCE BOOKS:

1. Microcontrollers-Theory and Applications by Ajay V Deshmukh, McGraw Hills
2. Microcontrollers by Kennith J ayala, Thomson publishers
3 Microprocessor and Microcontrollers by Prof C.R.Sarma

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(D0606121) VLSI TECHNOLOGY
(Common to PE, ES, DSCE)

UNIT I INTRODUCTION TO MOS TECHNOLOGY

Overview of VLSI Design Methodologies**,** VLSI Design flow, Styles of VLSI Design, CAD Technology, MOS Transistors and its Trends.

UNIT II BASIC ELECTRICAL PROPERTIES OF MOS

I_{ds}-V_{ds} Relationships, Threshold voltage V_t, g_m, g_{ds} and W_o, Pass Transistor, MOS Z_{pu}/Z_{pd}, MOS Transistor circuit model.

UNIT III CMOS DESIGN

CMOS Logic, CMOS Gate Design, Transmission Gate Logic Design, Bi-CMOS Inverters, Latch-up in CMOS circuits.

UNIT IV LAYOUT DESIGN AND TOOLS

Transistor structures, Wires and Vias, Scalable Design rules, Layout Design tools.

UNIT V LOGIC GATES & LAYOUTS

Static Complementary Gates, Switch Logic, Alternative Gate Circuits, Low Power Gates, Resistive and Inductive Interconnect Delays.

UNIT VI COMBINATIONAL LOGIC NETWORKS

Layouts, Simulation, Network Delay, Interconnect Design, Power Optimization, Switch Logic Networks, Gate and Network Testing.

UNIT VII SEQUENTIAL SYSTEMS

Memory Cells and Arrays, Clocking Disciplines, Design, Power Optimization, Design Validation and Testing.

UNIT VIII FLOOR PLANNING & ARCHITECTURE DESIGN

Floor Planning Methods, Off-Chip Connections, High level Synthesis, Architecture for Low Power, SOCs and Embedded CPU Architecture Testing.

TEXT BOOKS:

1. K. Eshraghian etal.(3 authors), "Essentials of VLSI Circuits and Systems", PHI of India Ltd., 2005.
2. Wayne Wolf, "Modern VLSI Design", 3/E, Pearson Education, fifth Indian Reprint, 2005.
3. Sung-Mo Kang and Yusuf Leblebici, "CMOS Digital Integrated Circuits Analysis and Design" TATA TATA McGraw Hill, 3rd Edition, 2003.

REFERENCES:

1. N.H.E Weste, K.Eshraghian, "Principals of CMOS Design", Addison Wesley, 2nd Edition.
2. Ken Martin, "Digital Integrated Circuits Design" oxford University Press, 2nd impression, 2005.

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(D4391121) POWER CONVERTERS LAB

Choose any ten experiments from the following list

1. Single phase half controlled converter with R and R-L Load
2. Single phase full controlled converter with R and R-L Load
3. Three phase half controlled converter with R and R-L Load
4. Three phase full controlled converter with R and R-L Load
5. Single phase AC Voltage controller with R and R-L Load
6. Three phase half controlled AC Voltage controller with R and R-L Load
7. Three phase full controlled AC Voltage controller with R and R-L Load
8. Single phase cycloconverter
9. McMurray full bridge inverter
10. Single phase dual converter with R-L load
11. Simple series and parallel inverter
12. Thyristorised chopper

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(D4392121) SIMULATION OF POWER CONVERTERS LAB

NOTE: The first seven experiments are compulsory. Three experiments can be chosen from the remaining

1. Simulation of firing schemes: Ramp, Cosine, PWM.
2. Simulation of Single phase fully controlled converter with R and R-L load using MATLAB/PSIM.
3. Simulation of Three phase fully controlled converter with R and R-L load using MATLAB/PSIM.
4. Simulation of Single phase AC Voltage controller with R and R-L load using MATLAB/PSIM.
5. Simulation of Three phase full controlled AC Voltage controller with R and R-L Load using MATLAB/PSIM.
6. Simulation of three phase inverter in 120^0 conduction mode load connected both in star & delta.
7. Simulation of three phase inverter in 180^0 conduction mode load connected both in star & delta.
8. Simulation of step-down & step-up choppers.
9. Simulation of buck & boost converter.
10. Simulation of cuk converter.
11. Simulation of z-source inverter.
12. Simulation of Single phase cyclo-converter.
13. PWM pulse generation through MATLAB program.

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(D4307122) ADVANCED POWER SEMICONDUCTOR DEVICES AND PROTECTION

UNIT I BJTS

Introduction- vertical power transistor structures-I-V characteristics-physics of BJT operation switching characteristics-break down voltages-second break down-on-state losses-safe operation areas design of drive circuits for BJTs-snubber circuits for BJTs and darlingtons

UNIT II POWER MOSFETS

Introduction-basic structures-I-V characteristics-physics of device operation-switching characteristics-operation limitations and safe operating areas-design of gate drive circuits-snubber circuits

UNIT III GATE TURN-OFF THYRISTORS

Introduction-basic structures-I-V characteristics-physics of device operation-GTO switching characteristics-snubber circuits-over protection of GTOs.

UNIT IV INSULATED GATE BIPOLAR TRANSISTORS

Introduction-basic structures-I-V characteristics-physics of device operation-Latch in IGBTs-switching characteristics-Device limits and safe operating areas-drive and snubber circuits

UNIT V EMERGING DEVICES AND CIRCUITS

Introduction-Power junction field effect transistors-field controlled Thyristor-JFET based devices versus other power devices-MOS controlled Thyristors-high voltage integrated circuits-new semiconductor materials

UNIT VI PASSIVE COMPONENTS AND ELECTROMAGNETIC COMPATIBILITY

Introduction-design of inductor-transformer design-selection of capacitors-resistors current measurements-heat sinking circuit lay out –Electromagnetic Interference (EMI)-Sources of EMI-Electromagnetic Interference in Power Electronic Equipment

UNIT VII NOISE

Noise sources in SMPS-Diode Storage Charge Noise-Noise generated due to switching-Common noises sources in SMPS-Noises Due to High frequency transformer-How the conducted noise is measured - minimizing EMI-EMI shielding-EMI standards.

UNIT VIII PROTECTION OF DEVICES & CIRCUITS

Cooling & Heat sinks – Thermal modeling of powerswitching devices- snubber circuits – Reverse recovery transients – Supply and load side transients – voltage protections – current protections.

TEXT BOOKS :

1. Power Electronics-Md.H.Rashid –Pearson Education Third Edition -First Indian reprint 2004
2. Power Electronics- Ned Mohan, Tore M.Undeland and William P.Robbins –John Wiley & Sons -2nd Edition.

REFERENCE BOOKS :

1. Power Electronics Circuits-Vithayathil
2. Power Electronics Circuits-W.C. Lander

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(D4308122) MODERN POWER ELECTRONICS

UNIT I MODERN POWER SEMICONDUCTOR DEVICES

Modern power semiconductor devices- MOS Turn Off Thyristor (MTO) – Emitter Turn Off Thyristor (ETO) – Integrated Gate – Commutated thyristor (IGCTs) – MOS – controlled thyristors (MCTs) – Static induction Thyristors (SITHs) – Power integrated circuits (PICs) – Symbol, structure and equivalent circuit- comparison of their features.

UNIT II RESONANT PULSE INVERTERS

Resonant pulse inverters – series resonant inverters- series resonant inverters with unidirectional switches – series resonant inverters with bidirectional switches- analysis of half bride resonant inverter- evaluation of currents and Voltages of a simple resonant inverter – analysis of half bridge and full bridge resonant inverter with bidirectional switches – Frequency response of series resonant inverter- for series loaded inverter – for parallel resonant inverters – Voltage control of resonant inverters-class E resonant inverter – class E resonant rectifier- evaluation of values of C's and L's for class E inverter and Class E rectifier – numerical problems.

UNIT III RESONANT CONVERTERS

Resonant converters- zero current switching resonant converters – L type ZCS resonant converter- M type ZCS resonant converter – zero voltage Switching resonant converters – comparison between ZCS and ZVS resonant converters- Two quadrant ZVS resonant converters – resonant dc – link inverters- evaluation of L and C for zero current switching inverter – Numerical problems.

UNIT IV MULTILEVEL INVERTERS

Multilevel concept- Classification of multilevel inverters – Diode clamped Multilevel inverter- Principle of operation – main features- improved diode clamped inverter – principle of operation – Flying capacitors multilevel inverter – principle of operation – main features.

UNIT V MULTILEVEL INVERTERS (CONTINUED)

Cascaded multilevel inverter – principle of operation – main features- multilevel inverter applications – reactive power compensation – back to back intertie system – adjustable drives – switching device currents – dc link capacitor voltage balancing –features of Multilevel inverters – comparisons of multilevel converters.

UNIT VI DC POWER SUPPLIES

DC power supplies – classification- switched mode dc power supplies – fly back Converter- forward converter- push –pull converter –half bridge converter –Full bridge converter – Resonant DC power supplies- bidirectional power supplies- Application.

UNIT VII AC POWER SUPPLIES

AC power supplies – classification – switched mode ac power supplies Resonant AC power supplies-bidirectional ac power supplies – multistage conversions- control circuits- applications.

UNIT VIII POWER CONDITIONERS AND UNINTERRUPTIBLE POWER SUPPLIES

Introduction- power line disturbances – power conditioners- uninterruptible power supplies- applications

TEXT BOOKS:

1. Power Electronics: Mohammed H.Rashid-Pearson Education- Third Edition –first Indian reprint-2004
2. Power Electronics – Ned Mohan, Tore M.Undeland and William P.Robbind – John wiley & Sons – Second Edition.

REFERENCE BOOKS:

1. Introduction to Modern Power Electronics - Andrzej M. Trzynadlowski - Second edition - John wiley & Sons

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(D4309122) SPECIAL MACHINES AND CONTROL

UNIT I STEPPER MOTORS

Constructional features, Principle of operation, Modes of excitation torque production in Variable Reluctance (VR) stepping motor, Dynamic characteristics, Drive systems and circuit for open loop control, closed loop control of stepping motor.

UNIT II SWITCHED RELUCTANCE MOTORS

Mathematical model of Switched Reluctance Motor-Operating principle-Construction and functional Aspects-Average torque and Energy Conversion Ratio-The Commutation windings-The flux current position curve fitting, Control Techniques

UNIT III PERMANENT MAGNET BRUSHLESS DC MOTORS

Modelling of Permanent Magnet Brushless DC Motor – Operating principle-Mathematical modeling of PM Brushless DC motor-PMDC Motor Drive Scheme. Torque and emf equation, Torque-speed characteristics

UNIT IV PERMANENT MAGNET SYNCHRONOUS MOTORS

Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power Controllers, Torque speed characteristics

UNIT V SERVOMOTORS

Servomotor – Types – Constructional features – Principle of Operation – Characteristics - Control – Microprocessor based applications

UNIT VI AC TACHOMETERS

Schematic diagram, Operating principle, numerical problems

UNIT VII LINEAR MOTORS

Linear Motors: Linear Induction Motor (LIM) Classification – Construction – Principle of operation – Concept of Current sheet –Goodness factor – DC Linear Motor (DCLM) types – Circuit equation – DCLM control-applications

UNIT VIII CONTROLLERS FOR MACHINES:

Drive concept for special machines--Microprocessors based controller for PMBLDC motor-- Self control, Vector control, Current control Schemes for PMSM

TEXT BOOKS:

2. N.Mohan, Undeland & Robbins: Power Electronics Converters, Applications & Design
3. Power Electronics Control of AC Motors-MD Murphy & FG Turn Bull Pergman Press.
4. Miller, T.J.E. “Brushless Permanent Magnet and Reluctance Motor Drives”, Clarendon Press, Oxford, 1989.
5. Kenjo, T and Naganori, S “Permanent Magnet and brushless DC motors”, Clarendon Press, Oxford, 1989.

REFERENCES:

1. Kenjo, T, “Stepping Motors and their Microprocessor control”, Clarendon Press, Oxford, 1989.
2. Naser A and Boldea I, “Linear Electric Motors: Theory, Design and Practical Application”, Prentice Hall Inc., New Jersey,1987
3. Floyd E Saner,”Servo Motor Applications”, Pittman USA, 1993.

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(D4310122) POWER ELECTRONIC CONTROL OF AC DRIVES

UNIT I INTRODUCTION TO AC DRIVES

Introduction to motor drives-torque production- Equivalent circuit analysis-Speed-Torque characteristics with variable voltage operation, variable frequency operation, constant v/f operation-Induction motor characteristics in constant torque and field weakening regions

UNIT II CONTROL OF INDUCTION MOTOR DRIVES AT STATOR SIDE

Scalar control-Voltage fed inverter control-Open loop volts/Hz Control-Speed control slip regulation- Speed control with torque and flux control-Current controlled voltage fed inverter drive-Current fed inverter control-Independent current and frequency control-Speed and flux control in current fed inverter drive-Volts/Hertz Control current fed-Inverter drive-Efficiency optimization control by flux program

UNIT III CONTROL OF INDUCTION MOTOR AT ROTOR SIDE

Slip power recovery drives-Static Kramer Drive-Phasor diagram-Torque expression-Speed control of Kramer Drive-Static Scheribus Drive- Modes of operation

UNIT IV VECTOR CONTROL OF INDUCTION MOTOR DRIVES

Principles of Vector Control-Vector Control Methods-Direct method of Vector control-Adaptive control principles-Self tuning regulator-Model referencing control

UNIT V CONTROL OF SYNCHRONOUS MOTOR DRIVES

Synchronous motor and its characteristics – control strategies – constant torque angle control-Unity power factor control-Constant mutual flux linkage control

UNIT VI CONTROLLERS

Flux weakening operation- Maximum speed-Direct flux weakening algorithm – Constant torque mode controller-Flux Weakening controller- Indirect flux weakening – Maximum permissible torque-Speed control scheme-Implementation strategy – Speed controller design

UNIT VII VARIABLE RELUCTANCE MOTOR DRIVE

Variable reluctance motor drives- Torque Production in the variable reluctance motor- Drive characteristics and control principles- Current control variable reluctance servo drive.

UNIT VIII BRUSHLESS DC MOTOR DRIVES

Three phase full wave Brushless dc motor – Sinusoidal type of Brushless dc motor-Current controlled Brushless dc servo drives

TEXT BOOKS

1. Electric Motor Drives Pearson modeling, analysis and control R.Krishnan – Publication -1st Edition -2002
2. Modern Power Electronics and AC drives-B.K Bose-Pearson Publication -1ST Edition
3. Power Electronic Control of AC motors- MD Murphy & FG Turn Bull Pergman Press(For Chapters II,III, V) – 1st Edition
4. Power Electronics and AC drives-B.K Bose-Prentice Hall Publication -1ST Edition

REFERENCES

1. Power Electronics Circuits , Devices and Application- M.H Rashid –PHI 1995
2. Fundamentals of Electric Drives –GK Dubey- Narora Publications -1995

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(D4311122) FACTS CONTROLLERS & APPLICATIONS

UNIT-I INTRODUCTION

FACTS Concepts: Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits from FACTS controllers.

UNIT-I1 STATIC SHUNT COMPENSATION

Static shunt compensation: Objectives of shunt compensation, mid point voltage regulation voltage instability prevention, improvement of transient stability, Power oscillation damping.

UNIT-I1I METHODS OF CONTROLLABLE VAR GENERATION:

Variable impedance type static var generators: Thyristor Controlled and Thyristor Switched Reactor (TCR and TSR), Thyristor Switched Capacitor (TSC), Fixed Capacitor Thyristor Controlled Reactor Type Var Generator FC-TCR, Thyristor Switched Capacitor- Thyristor Controlled Reactor Type Var Generator; Switching converter type var generators, Hybrid var generators.

UNIT-IV SVC AND STATCOM

Static Var Compensators: SVC and STATCOM-The Regulation Slope, Transfer Function and Dynamic Performance-Transient Stability Enhancement and Power Oscillation Damping; Comparison between STATCOM and SVC: V-I and V-Q Characteristics, Transient Stability, Response Time, Capability to Exchange Real Power, Operation with Unbalanced AC System, Loss Versus Var Output Characteristic.

UNIT-V STATIC SERIES COMPENSATION

Concept of series capacitive compensation, improvement of transient stability, power oscillation damping; Variable Impedance Type Series Compensators-GTO Thyristor-Controlled Series Capacitor-(GCSC), Thyristor-Switched Series Capacitor(TSSC), Thyristor-Controlled Series Capacitor(TCSC), Basic Operating Control Schemes For GCSC,TSSC and TCSC.

UNIT-VI SWITCHING CONVERTER TYPE SERIES COMPENSATORS

Static Synchronous Series Capacitor(SSSC), Transmitted Power Versus Transmission Angle Characteristic, Control Range and VA Rating, Capability to Provide Real Power Compensation, Internal Control; External Control for Series Reactive Compensators.

UNIT-VII STATIC VOLTAGE AND PHASE ANGLE REGULATORS: TCVR AND TCPAR:

Voltage and Phase Angle Regulation, Power Flow Control by Phase Angle Regulators, Real and Reactive Loop Power Flow Control; Approaches to Thyristor –Controlled Voltage and Phase Angle Regulators (TCVRs and TCPARs)-Continuously Controllable Thyristor Tap Changers.

UNIT-VIII UNIFIED POWER FLOW CONTROLLER (UPFC)

Introduction: The Unified Power Flow Controller-Basic Operating Principles, Conventional Transmission Control Capabilities, Independent Real and Reactive Power Flow Control, Control Structure, Basic Control System for P and Q Control.

TEXT BOOKS:

1. N.G.Hingorani & L.Gyugyi, Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems, IEEE Press, 1999.
2. X.P. Zang, C. Rehtanz and B. Pal, Flexible AC Transmission Systems: Modeling and Control, Birkhauser, 2006.
3. Y. H. Song and A. T. Johns, Flexible AC Transmission Systems, IET, 1999.
4. R. Mohan Mathur, Rajiv K. Varma, "Thyristor-based facts controllers for electrical transmission systems", Wiley-IEEE, 2002
5. K.R. Padiyar, "Facts Controllers in Power Transmission & Distribution", New Age International Publishers

REFERENCE BOOKS:

1. Enrique Acha, Claudio R. Fuerte-Esquivel, Hugo Ambriz-Perez, Cesar Angeles-Camacho, "FACTS: Modeling and Simulation in Power Networks", John Wiley & Sons Ltd., 2004.
2. S. Sivanagaraju, S.Sathyabarayana, "Electric Power Transmission and Distribution", Pearson Education, 2009.
3. Kalyan K. Sen & Mey Ling Sen, "Introduction to FACTS controllers: Theory, Modeling, and Applications", Wiley-IEEE, 2009.
4. Narain G. Hingorani, Laszlo Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press Standard Publishers Distributors, 2000.
5. M.Noroozian et.al "Use of UPFC for optimal power flow control", Transactions on Power Delivery, Vol.12, No.4, oct 1997, pp 1629-1634

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(D4312122) H.V.D.C. TRANSMISSION

UNIT 1 H.V.D.C. TRANSMISSION

General considerations, Power Handling Capabilities of HVDC Lines, Basic Conversion principles, static converter configuration.

UNIT 2 STATIC POWER CONVERTERS

3-pulse, 6-pulse and 12-pulse converters, converter station and Terminal equipment, commutation process, Rectifier and inverter operation, equivalent circuit for converter – special features of converter transformers.

UNIT 3 HARMONICS

Harmonics in HVDC Systems, Harmonic elimination, AC and DC filters

UNIT 4 CONTROL OF HVDC CONVERTERS AND SYSTEMS

constant current, constant extinction angle and constant Ignition angle control. Individual phase control and equidistant firing angle control, DC power flow control.

UNIT 5 INTERACTION BETWEEN HV AC AND DC SYSTEMS

Voltage interaction, Harmonic instability problems and DC power modulation.

UNIT 6 MULTI-TERMINAL DC LINKS AND SYSTEMS

series, parallel and series parallel systems, their operation and control.

UNIT 7 TRANSIENT OVER VOLTAGES IN HV DC SYSTEMS

Over voltages due to disturbances on DC side, over voltages due to DC and AC side line faults

UNIT 8 CONVERTER FAULTS AND PROTECTION IN HVDC SYSTEMS Converter faults, over current protection - valve group, and DC line protection, circuit breakers. Over voltage protection of converters, surge arresters.

REFERENCE BOOKS:

1. K.R.Padiyar : High Voltage Direct current Transmission, Wiley Eastern Ltd., New Delhi – 1992.
2. E.W. Kimbark : Direct current Transmission, Wiley Inter Science – New York.
3. J.Arillaga : H.V.D.C.Transmission Peter Peregrinus ltd., London UK 1983
4. E.Uhlman : Power Transmission by Direct Current, Springer Verlag, Berlin Helberg – 1985.

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ELECTRICAL & ELECTRONICS ENGINEERING

M.Tech (Power Electronics) II-Sem	**T**	**P**	**C**
	4	**0**	**4**

(D4313122) DIGITAL CONTROL SYSTEMS

UNIT I SAMPLING AND RECONSTRUCTION

Introduction, sample and hold operations, sampling theorem, reconstruction of original sampled signal to continuous time signal

Z-Transforms

Introduction, Linear difference equations, pulse response, Z-transforms, Theorems of Z transforms, the inverse Z-transforms, Modified Z-transforms

UNIT II Z-PLANE ANALYSIS OF DISCRETE TIME CONTROL SYSTEMS

Z-transform method for solving difference equations: pulse transform function, block diagram analysis of sampled –data systems, mapping between s-plane and z-plane; primary strips and complementary strips

UNIT III STATE SPACE ANALYSIS

State space representation of discrete time systems, pulse transfer function matrix, solving discrete time state space equations, state transition matrix and its properties methods for computation of state transition matrix, discretization of continuous time state-space equations

UNIT IV CONTROLLABILITY AND OBSERVABILITY

Concepts of controllability and observability, tests for controllability and observability, duality between controllability and observability, controllability and observability conditions for pulse transfer functions

UNIT V STABILITY ANALYSIS

Stability analysis of closed loop systems in the Z-plane, Jury stability criterion test-Stability analysis by use of the bilinear transformation and routh stability criterion. Stability analysis using liapumov theorems

UNIT VI DESIGN OF DISCRETE TIME CONTROL SYSTEM BY CONVENTIONAL METHODS

Design of digital control based on the frequency response methods-Bilinear transformation and design procedure in the w-plane, lead, lag and Lead-lag compensators and digital PID controllers. Design digital control through dead beat response methods.

UNIT VII STATE FEEDBACK CONTROLLERS AND OBSERVERS

Design of state feedback controller through pole placement-Necessary and sufficient conditions, Ackerman's formula, State observers-Full order and Reduced Order observer

UNIT VIII LINEAR QUADRATIC REGULATORS

Min/Max principle, Linear Quadratic Regulators, Kalman Filters, State Estimation through kalman Filters, Introduction to adaptive controls

TEXT BOOKS:

1. Discrete Time Control Systems-K.Ogata Pearson Education
2. Digital Control systems and State Variables methods by M.Gopal

REFERENCE BOOKS:

1. Digital Control Engineering Kuo, Oxford University
2. Digital Control Engineering M.Gopal

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(D0609122) MICRO COMPUTER SYSTEMS DESIGN
(Common to PE, DS&CE)

UNIT I REVIEW OF 8086 PROCESSOR

Architecture, Register organization, Addressing Modes and Instruction Set (Brief treatment only), Difference between 8086 and 8088 with rest to pin structures

UNT II 80286 MICRO PROCESSORS

Architecture, Register Organization, Addressing Modes and instruction sets of 80286 (brief treatment only)

UNIT III 80386, AND 80486 MICRO PROCESSORS

Architectural features, Register Organization, Memory management, Virtual 8086 mode, The Memory Paging Mechanism, Pin Definitions of 80386 and 80486 (brief treatment).

UNIT IV PENTIUM AND PENTIUM PRO PROCESSORS

The Memory System, Input/output system, Branch Prediction Logic, Cache Structure, Pentium Registers, Serial Pentium pro features.

UNIT V PENTIUM IV AND DUAL CORE MICRO PROCESSORS

Architecture, Special Registers and Pin Structures (brief treatment only)

UNIT VI I/O PROGRAMMING

Fundamentals of I/O, Considerations Programmed I/O, Interrupt I/O, Block Transfers and DMA, I/O Design Example.

UNIT VII MULTI PROCESSOR SYSTEMS

Interconnection topologies, software aspects of multi micro processor systems, Numeric processor 8087, I/O processor 8089, Bus arbitration and control, Tightly coupled and loosely coupled systems.

UNIT VIII ARITHMETIC COPROCESSOR, MMX AND SIMD TECHNOLOGIES

Data formals for Arithmetic Coprocessor, Internal Structure of 8087 and Advanced Coprocessors, Instruction Set (brief treatment)

TEXTBOOKS:

1. Barry, B. Brey, "The Intel Microprocessors,"8th Edition Pearson Education, 2009.
2. A.K. Ray and K.M. Bhurchandi,"Advanced Microprocessor and Peripherals," TMH

REFERENCES:

1. YU-Chang, Glenn A. Gibson, "Micro Computer Systems: The 8086/8088 FamilyArchitecture
2. Programming and Design" 2nd Edition, Pearson Education, 2007
3. Douglas V. Hall, "Microprocessors and Interfacing," Special Indian Edition, 2006.

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(D5504122) EMBEDDED SYSTEMS DESIGN
(Common to PE & ES)

UNIT I EMBEDDED DESIGN LIFE CYCLE

Introduction, Product Specification, Hardware/software partitioning, Iteration and Implementation, Detailed hardware and software design, Hardware/Software integration, Product Testing and Release, Maintaining and upgrading existing products.

UNIT II SELECTION PROCESS

Packaging the Silicon, Adequate Performance, RTOS Availability, Tool chain Availability, Other issues in the Selection process, partitioning decision: Hardware/Software Duality, Hardware Trends, ASICs and Revision Costs

UNIT III DEVELOPMENT ENVIRONMENT

The Execution Environment, Memory Organization, System Startup. Special Software Techniques: Manipulating the Hardware, Interrupts and Interrupt service Routines (ISRs), Watchdog Times, Flash Memory, Design Methodology. Basic Tool Set: Host – Based Debugging, Remote Debuggers and Debug Kernels, ROM Emulator, Logic Analyzer.

UNIT IV BDM

Background Debug Mode, Joint Test Action Group (JTAG) and Nexus-ICE – Integrated Solution: Bullet Proof Run Control, Real time trac, Hardware Break points, Overlay memory, Timing Constrains, Usage Issue, Setting the Trigger.

UNIT V TESTING

Why Test? When to Test? Which Test? When to Stop? Choosing Test cases, Testing Embedded Software, Performance Testing Maintenance and Testing

UNIT VI WRITING SOFTWARE FOR EMBEDDED SYSTEMS

The compilation Process, Native Versus Cross-Compilers, Runtime Libraries, Writing a Library, Using alternative Libraries, using a standard Library

UNIT VII DEBUGGING TECHNIQUES

Debugging techniques, the role of the development system

UNIT VII BUFFERING AND OTHER DATA STRUCTURES

What is a buffer? Linear Buffers, Directional Buffers, Double Buffering, Buffer Exchange, Linked Lists, FIFOs, Circular Buffers, Buffer Under run and Overrun, Allocating Buffer Memory

TEXTBOOKS

1. Embedded System Design – Introduction to Processes, Tools, Techniques, Arnold S Burger, CMP Books , 2002.
2. Embedded Systems Design by Steve Heath, Newnes, 2nd edition 2003, EDN series for design engineers.

REFERENCES:

1. An embedded software primer by David E.Simon, Pearson education, 2008, Low price edition.

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ELECTRICAL & ELECTRONICS ENGINEERING

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(D4394122) POWER ELECTRONIC DRIVES LAB

1. 1-Φ IGBT based PWM Inverter fed Induction Motor
2. 1-Φ to 3- Φ IGBT based PWM Inverter fed Induction Motor
3. Four quadrant operation of a chopper fed DC motor
4. SCR based VSI fed 3- Φ Induction Motor
5. Speed control of Permanent Magnet Synchronous Motor using Intelligent Power Module
6. Speed control of Brushless DC Motor using Intelligent Power Module
7. Speed control of Switched Reluctance Motor using Intelligent Power Module
8. Speed control of Induction Motor using Intelligent Power Module
9. 3- Φ Fully controlled rectifier fed DC motor
10. 3- Φ AC voltage controller fed Induction Motor
11. Flow of execution of signal generation using FPGA

M.Tech (Power Electronics) II-Sem

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(D4395122) POWER SYSTEM SIMULATION LAB

Experiments using E-TAP Software

1. Load Flow Analysis
2. Short circuit Analysis
3. Motor Starting Analysis
4. Transient Stability Analysis
5. Harmonic Analysis

Experiments using POWER WORLD Software

1. Load Flow Analysis
2. Optimal Power flow & Economic Dispatch
3. Stability Study(PV&QV curves)
4. Short circuit Analysis
5. Contingency Analysis